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ABSTRACT

While studies of college-level readers have yielded evidence both for and against the use of phonological or speech recoding in the recognition of written words, no consistent picture of when recoding occurs has yet emerged. However, one model, the adjunct access model, can account for the previous research findings. According to this model, recoding will not occur when a subject is aware that a speech code may be detrimental to task performance, but will occur at least some of the time when a speech code is not detrimental. The model posits that direct lexical access (word recognition without prior speech recoding) is followed by an automatic but slow adjunct access of the phonological representation of the word. Using this model, the effects of phonological relationships between words, which were previously interpreted as evidence for speech recoding occurring before word recognition, can now be interpreted as being due to the adjunct access of phonological representations occurring after word recognition. An experiment conducted to test whether semantic relatedness between word pairs would influence the time it takes to make decisions based on phonological characteristics confirmed the model's predictive validity. (FL)

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CENTER FOR THE STUDY OF READING

Technical Report No. 247

PHONOLOGICAL REPRESENTATIONS IN VISUAL WORD RECOGNITION: THE ADJUNCT ACCESS MODEL

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Abstract

Studies of college-level readers have yielded evidence both for and against the use of phonological or speech recoding in the recognition of written words. A consistent picture of when recoding occurs has not emerged. The adjunct access model presented in this paper can account for the previous experimental findings. According to this model, recoding will not occur when the subject is aware that a speech code may be detrimental to task performance. It will occur at least some of the time when a speech code is not detrimental. However, direct lexical access (i.e., word recognition without prior speech recoding) is followed by an automatic but slow adjunct access of the phonological representation of the word. Effects of phonological relationships between words, previously interpreted as evidence for speech recoding occurring before word recognition, are reinterpreted as being due to the adjunct access of phonological representations occurring after word recognition. The detailed version of the model presented predicts that semantic relatedness between word pairs will influence the time it takes to make decisions based on phonological characteristics. The experiment reported supports this prediction.

Phonological Representations in Visual Word Recognition: The Adjunct Access Model

The process of recognizing a written word begins with sensing the shapes on the page and ends when contact is made with a representation of the word stored in the reader's internal dictionary or lexicon. One important question about this process is whether the visual representations are recoded into speech-like representations. A great deal of research has been directed toward determining whether visual word recognition by skilled (i.e., college-level) readers is mediated by speech or is direct, based upon visual or orthographic representations. For reviews of this research see Bradshaw (1975); Davelaar, Coltheart, Besner, & Jonasson (1978); Kleiman (1975); and Meyer, Schvaneveldt, & Ruddy (1974a).

Recent research strongly supports the position that direct access is possible for skilled readers (Bradshaw, 1975; Coltheart, Davelaar, Jonasson, & Besner, 1977; Davelaar, et al., 1978; Kleiman, 1975; Shulman, Hornak, & Sanders, 1978). However, mediated access occurs under certain circumstances, and several studies have attempted to determine the conditions that minimize or maximize its use. In these studies, which are reviewed below, subjects were presented with strings of letters and were to decide whether they formed real words (a lexical decision task). Reaction times and error rates were measured for various types of words and nonwords. The types of nonwords or distractors used in these studies have been nonwords that sound like real words (pseudohomophones, such as brane), nonwords that follow the orthographic patterns of English and are therefore pronounceable (pseudowords, such as glods), and nonwords that violate the orthographic patterns of English (illegal nonwords, such

as ldgso). The assumption underlying this task is that to make the required decision, subjects must make contact with internal representations for the words, and fail to do so for the nonwords.[1] The time to make a lexical decision about a word therefore reflects the time it takes for lexical access to occur.

Evidence in support of mediated access was found in a study by Rubenstein, Lewis, and Rubenstein (1971). They measured the time it took subjects to make lexical decisions for five types of letter strings: (a) high-frequency members of homophonic word pairs (e.g., sale); (b) low-frequency members of homophonic word pairs (e.g., sail); (c) words that are not homophones (e.g., tree); (d) pseudowords (e.g., glods); and (e) pseudohomophones (e.g., brane). If lexical access is mediated by a speech code, subjects would sometimes first access the wrong member of homophonic word pairs. Rubenstein et al. assumed that this incorrect word would be rejected on the basis of a spelling check, and searching the lexicon for the correct word would then resume. If the lexicon is searched in order of word frequency, this extra access and reject step would occur only for low-frequency members of homophonic word pairs. Since extra processes take time, lexical decisions should be slower for the low-frequency homophones than for comparable words that are not homophones. Rubenstein et al. report finding this homophone effect. Likewise, when a pseudohomophone is presented, a word will be accessed and rejected, and so the time to make a nonword decision should be longer for pseudohomophones than for pseudowords. Rubenstein et al. also found this predicted pseudohomophone effect.

Coltheart et al. (1977) raised several criticisms of the Rubenstein et al. study. The homophones and comparison words were not equated on factors such as word frequency and part of speech, which have been shown to affect lexical decisions. Also, the pseudohomophones may have differed from the other nonwords in visual similarity to real words. That is, reaction times may have been longer for the pseudohomophones because they looked more like real words, not because they sounded more like real words. Adding these controls to a replication of the Rubenstein et al. study, Coltheart et al. found the pseudohomophone effect, but not the homophone effect. This suggested that subjects typically used direct access, but when they failed to find a lexical match, an additional check using mediated access may have occurred.

Davelaar et al. (1978) extended this line of work. In their first experiment, in which the nonwords were pseudohomophones, they failed to find a homophone effect. However, they obtained a homophone effect in their second experiment, in which the nonwords were pseudowords. In their third experiment, they clearly demonstrated that the homophone effect depends on the type of nonwords in the stimulus set. The stimuli for this experiment were constructed in three segments. The first and third segments both contained low frequency members of homophonic words pairs and nonhomophonic control words. The nonwords in the first third were pseudowords that did not sound like real words (e.g., slint), while the nonwords in the final third were pseudohomophones (e.g., grone). The middle or transitional segment contained 20 words and 20 nonwords. The first 10 nonwords to appear in this segment were pseudowords, the last 10 were pseudohomophones. The results showed a homophone effect in the

first third, but not in the final third. For the transitional segment, error rates were much higher for the pseudohomophones than the pseudowords.

The findings of Davelaar et al. suggest that direct access occurs when subjects realize a speech code would be detrimental to performance, as when pseudohomophones were presented. When a speech code would not disrupt the decision, mediated access occurs at least some of the time. These results suggest that subjects have control over the use of mediated or direct access.[2]

Meyer et al. (1974a) described another experimental effect that has been taken as evidence of mediated access. They presented pairs of letter strings, and subjects decided whether both strings formed words (a dual lexical decision task). The critical stimuli were two sets in which both strings formed words and the words in each pair were spelled alike after the first letter. In one of these sets the words in each pair were phonologically similar (e.g., bribe-tribe, fence-hence), while in the other set the words in each pair were phonologically dissimilar (e.g., couch-touch, freak-break). In order to form appropriate controls, the experimenters rearranged the words within each set into pairs that were both orthographically and phonologically dissimilar (e.g., bribe-hence, couch-break). The distractor pairs contained either one or two pseudowords.

The important result was an effect of the phonological relationship of the words. Decisions for the phonologically similar pairs were faster than decisions for the relevant control pairs, while decisions for the phonologically dissimilar pairs were slower and more error-prone than for their controls. These same results were found in a second experiment in which the words were presented successively and a separate decision required for each.

The facilitation for pairs of words that were both orthographically and phonologically similar does not necessarily implicate a phonological code, as facilitation could be due to orthographic similarity alone. However, the interference that occurred when the words were orthographically similar but phonologically dissimilar clearly implies that phonological representations influenced the decision. Meyer et al. interpret this orthography-phonology conflict effect as evidence for mediated access.

Shulman et al. (1978) replicated the orthography-phonology conflict effect when the distractors were pseudowords, and also tested whether it occurs when the distractors are illegal nonwords. With illegal nonwords, the conflict effect did not occur; both types of orthographically similar word pairs showed facilitation as compared to the control pairs. Shulman et al. included some pairs of semantically related words and appropriate controls and found a priming effect. That is, semantically related word pairs (e.g., doctor-nurse) were responded to more quickly than unrelated pairs (e.g., bread-nurse). This provides evidence that lexical access did occur, even though words can be discriminated from illegal nonwords on the basis of orthographic regularity.

Shulman et al. interpreted their results as evidence for direct access. Since discriminating words from pseudowords is more difficult and takes more time than discriminating words from illegal nonwords, Shulman et al.'s results are consistent with the view that the use of phonological representations becomes more probable as the task becomes more difficult and time consuming.

The literature reviewed above appears inconsistent. If subjects can use direct access to make lexical decisions, and avoid mediated access when

a speech code interferes with performance (Davelaar, et al., 1978), why do Meyer et al. (1974a) and Shulman et al. (1978) find that an orthography-phonology conflict interferes with lexical decisions when the distractors are pseudowords? And why does this effect disappear when the distractors are illegal nonwords (Shulman, et al., 1978)? In this paper, an adjunct access model that resolves these inconsistencies will be presented.

According to the adjunct access model, lexical access will be direct when subjects are aware that a speech code could be detrimental to task performance. However, following word recognition via the direct route, there is a secondary or adjunct access of the phonological representation of the word. This adjunct access is automatic (i.e., not under the subject's control), but takes time, so that the critical factor in determining whether there will be an orthography-phonology conflict effect is the time it takes to make a decision after lexical access has occurred. That is, while the conflict effect shows that phonological representations influenced the decision, it does not imply that these representations became available via a prelexical access recoding process. Phonological information may have affected the decision after being retrieved from lexical memory.

The adjunct access model makes several assumptions about the structure of the lexicon, the process of lexical access, and decision processes. Each of these assumptions will be discussed below. Then an experimental test of one prediction of the model will be reported.

According to the model, the lexicon consists of three separate but interconnected stores: a phonological dictionary, an orthographic dictionary, and a semantic network. Most words that skilled readers encounter

are represented in all three stores, and the representations for each word are linked across stores. This is similar to Loftus' (1977) dictionary-network model, but in her model there is only one dictionary containing both orthographic and phonological information. The adjunct access model requires two dictionaries, since it is assumed that lexical access can occur through locating the word in either one, and the dictionaries would be organized differently to enable efficient access within each. It is also assumed that orthographically similar words are stored close together in the orthographic dictionary, phonologically similar words are stored close together in the phonological dictionary, and accessing a word in either store temporarily makes its neighbors easier to access. Word frequency also affects ease and speed of access.

When contact is made with the entry for a word in either the orthographic or phonological dictionary, access of the linked information in the semantic network quickly and automatically follows. The principles of spreading activation are assumed to hold in the semantic network (Collins & Loftus, 1975; Kleiman, 1980), and activation within the semantic network can feed back to the dictionaries and influence word recognition.

When written words are presented, access can be either direct (i.e., through the orthographic dictionary) or mediated (i.e., through the phonological dictionary after a recoding process). Mediated access will occur when a speech code is useful (e.g., in deciding if two words rhyme), will occur some of the time when a speech code is neither necessary nor harmful (e.g., in distinguishing real words from pseudowords), but will not occur when a speech code is detrimental (e.g., in distinguishing real words from

pseudohomophones, or when there is a conflict between orthography and phonology).[3]

Following direct access and the rapid semantic access it entails, there is an automatic but slow adjunct access of phonological information. This information is not a necessary part of visual word recognition, and will affect a decision based on direct access only if there is sufficient time before the decision is made. The rapid access of semantic information and the slow access of phonological information reflect skilled readers' use of attentional processes in prior reading. Most often, attention is directed to the meanings of words, and so, for well-practiced readers, orthographic forms and word meanings have become closely linked. The more distant links between orthographic and phonological representations are the result of those occasions when attention has been directed to the sounds of written words, as when reading aloud.

The main assumption about the decision process is that when a decision is based on one type or source of information, other irrelevant information can influence the decision if there is sufficient time for the irrelevant information to become available. This assumption is a main feature of a model of composite decision processes recently proposed by Logan (1980). According to Logan's model, evidence accumulates over time until a decision threshold is reached and a response emitted. The threshold is set by the subject and depends on various factors, such as the difficulty of the decision and whether instructions stress speed or accuracy. Since evidence accumulates over time, higher thresholds entail longer decision times.

When a stimulus set has two or more sources of information, the weight of each source in the decision is determined by three factors. One factor is the attentional processes or strategies that the subject controls. These enable the subject to assign high weights to relevant information. The second factor is automatic processes, which the subject does not control. Automatic processing can result in irrelevant sources of information contributing to the decision process. The third factor is the time elapsing between the availability of the relevant and irrelevant information. If the irrelevant information is not available before the decision is made, it cannot affect the decision. When it is available, the contribution of irrelevant information can be either facilitory or interfering, depending on whether it agrees or conflicts with the relevant information. That is, it is not simply the availability of irrelevant information that matters, but also its relationship to the relevant information. Logan uses a formal version of this model to account for the major findings in the Stroop and priming paradigms.

The account of the homophone and pseudohomophone effects within the adjunct access model is similar to that offered by Davelaar et al. (1978). When the subject is aware that a speech code might hinder performance, as when real words have to be discriminated from pseudohomophones, direct access is used and the homophone effect will not occur. Alternatively, when a speech code would not hinder performance, as when real words have to be discriminated from pseudowords, mediated access will be used at least some of the time, and the homophone effect will occur.[4] The pseudohomophone effect would be attributed to a final checking process via the

phonological dictionary that may occur when direct access does not locate a matching lexical entry.

The adjunct access model account of the orthography-phonology conflict effect differs from previous accounts. Specifically, the conflict effect is not taken as evidence of mediated access, but rather is attributed to the adjunct access of phonological information and the effect of this irrelevant phonological information on the decision process.

In the dual lexical decision task, lexical access will be direct once the subject becomes aware that a speech code can be detrimental. Direct access of the first word in each pair entails rapid access of the appropriate entry in the semantic network. Spreading activation from this entry would result in the semantically related prime effect found by Shulman et al. (1978). Locating the first word in the orthographic dictionary would also facilitate access of orthographically similar second words.

The orthography-phonology conflict effect occurs when the nonwords are pseudowords, but does not occur when they are illegal strings of letters. Discriminating real words from pseudowords is more difficult than discriminating real words from illegal strings. More information would be required in the former case than the latter, and so the decision threshold would be set higher. Since information accumulates over time, this model accounts for the longer decision times with pseudowords than with illegal nonwords found by Shulman et al. Finally, the model assumes a slow adjunct access of phonological information follows direct access of the orthographic information. When the threshold is set low and the decision is rapid, adjunct phonological access does not occur in time to affect the decision. When the threshold is set high and the decision is

slower, phonological information is accessed in time to affect the decision.

In addition to the assumptions of the adjunct access model already discussed, this account of the orthography-phonology conflict effect requires automatic processing of the phonological and orthographic relationships between the words. While no account will be given of the mechanism involved, there is evidence of automatic processing of this type. Neely (1977) found automatic processing of semantic relationships between words in the priming paradigm, and Logan and Zbordoff (1979) found automatic processing of the relationships between different dimensions of stimuli in the Stroop paradigm. In both cases, the evidence comes from studies designed so that automatic and attentional processes would have opposite effects on the time to make the required decision. The same logic applied to data provided by Donchin and McCarthy (Note 1) provides evidence for the automatic processing of orthography-phonology relationships.

In Donchin and McCarthy's experiments, subjects were presented with pairs of written words and decided whether the two words rhymed. In each of the two relevant experiments, the appropriate decision could always be determined from the orthographic relationship of the words. Subjects could therefore use attentional strategies to take advantage of this in making the rhyme decision. The two experiments differed in that in one, all of the rhyming pairs were orthographically dissimilar (e.g., moose-juice), and all of the nonrhyming pairs were orthographically similar (e.g., couch-touch), while in the other experiment each pair was either both orthographically and phonologically similar or not (e.g., cake-lake, desk-fork). Response times were much shorter when the words that looked alike also

rhymed. That is, an orthography-phonology conflict interfered with the rhyming decision even though attentional strategies could have used the orthographic relationship as a cue to the correct decision. Following the logic used by Neely (1977) and by Logan and Zbordoff (1979), this suggests the occurrence of automatic processing.

In addition to accounting for the previous findings, the adjunct access model also provides an untested prediction. According to this model, the orthography-phonology conflict effect should not be the only irrelevant information effect in making decisions about word pairs. In particular, when the decision is based on the phonological relationship of two visually presented words, semantic relatedness of the words should affect decision times. As previously discussed, when phonological information is relevant to a decision, mediated access will occur. Semantic access rapidly follows, and semantic relatedness is processed automatically (Neely, 1977). Therefore, information about semantic relatedness will be available to contribute to the decision.

In the experiment testing this prediction, subjects viewed pairs of words and decided whether the two words had the same number of syllables.[5] It was assumed that subjects use phonological representations of the words to make this decision. The words comprising each pair were either related or unrelated in meaning.

The adjunct access model makes two specific predictions about the results of this experiment. First, decisions for related word pairs should be faster than decisions for unrelated word pairs. This prediction is based on the role of spreading activation within the semantic network. Reading the first word will activate related lexical entries, and reduce

the lexical access time for the second word. This same prediction would, of course, be derived from any other model that incorporates spreading activation or logogens.

The second prediction is unique to the adjunct access model. It is that there should be an interaction of semantic relatedness and the decision of same or different number of syllables. The locus of this effect is the decision process, which can be affected by a dimension that is irrelevant to the decision. The effect can be either positive or negative, depending on the congruity of the irrelevant and relevant dimensions. Therefore, similarity in meaning should facilitate same decisions about phonological information, and inhibit different decisions.

Method

There were four stimulus types (see Table 1 for example): Type SR consisted of pairs in which the two words had the same number of syllables and were related in meaning; Type SU consisted of pairs in which the two words had the same number of syllables but were unrelated in meaning; Type DR consisted of pairs in which the two words had a different number of syllables but were related in meaning; Type DU consisted of pairs in which the two words had a different number of syllables and were unrelated in meaning. The stimuli were arranged so that within each decision the same words were used in the related and unrelated sets, as shown in the examples in Table 1. Relatedness was originally determined by the agreement of the authors, and then confirmed by norms from 10 subjects. These subjects, who did not participate in the main experiment, rated each word pair on a 1 to 5 scale, where 1 signified not at all related and 5 signified very

related. The mean ratings for the four word sets were: SR--4.3, DR--4.4, SU--1.4, DU--1.3.

The full stimulus set contained 576 pairs, 144 of each type. Forty-seven percent of the words had one syllable, 42% had two syllables, and 11% had three syllables. The stimuli were divided into four lists, each containing 36 pairs of each type. No words were repeated within a list and within each list the related and unrelated pairs for each decision were approximately balanced for length in terms of both syllables and letters. Each of the 28 subjects, all of whom were native English speaking University of Illinois undergraduates, received one of these lists.

Precautions were taken to insure that subjects could not simply use number of letters as a reliable cue to the decision. Some six-letter one-syllable words (e.g., knight, ground, square), and short two-syllable and three-syllable words (e.g., obey, oven, radio, piano) were used. In 69% of the same pairs the words did not have the same number of letters, in 16% of the different pairs the words had the same number of letters, and in 7% of the different pairs the word with more letters had fewer syllables.

The words in each pair were typed next to each other in lower-case letters on white cards. In a three field Iconix tachistoscope, the subject saw a centered fixation point and then initiated the trial by pressing an onset button. One second later, the fixation point was replaced by a pair of words. The subject decided whether the two words had the same number of syllables and pressed the appropriate response button. All subjects used their dominant hand to press the response button designating that the words had the same number of syllables. The instructions stressed both speed and accuracy. The 144 experimental trials were preceded by 32

practice trials with words not used in the experimental stimuli. Feedback was given only during the practice trials. The experimental lists were divided into four blocks of 36 trials, 9 of each type. The order of blocks within lists was counterbalanced across subjects. Stimuli within each block were presented in a different random order to each subject.

Insert Table 1 about here.

Results

Reaction times and error rates (averaged over subjects) for each of the four stimulus types are shown in Table 1. The error rates do not show any significant differences, and will not be considered further. The reaction time data for correct responses were analyzed both by subjects (F_1) and by items (F_2), and then min F's were calculated (Clark, 1973). Analysis of covariance was applied to the item data, with total number of syllables in the word pair as the single covariate. This prevented the long reaction times that occurred for multisyllable words from distorting the results.

Deciding the words in a pair had the same number of syllables was faster than deciding they had a different number of syllables, min F' (1,557) = 4.91, $p < .05$. This effect is probably due to all subjects using their dominant hands to respond same, and so is not of any theoretical interest.

Decisions for the related pairs were faster than decisions for the unrelated pairs, min F' (1,185) = 6.88, $p < .01$. That is, facilitation for processing of semantically related word pairs (as compared to unrelated pairs) occurs in the matching number of syllables task, as it does in the

lexical decision task. In the conjoined access model, as in many other models, this effect would be attributed to spreading activation within the semantic network affecting the encoding of the second word in the pair (Becker & Killion, 1977; Meyer, Schvaneveldt, & Ruddy, 1974b).

The interaction between decision type and relatedness was also significant, $\underline{\text{min}}\ F'\ (1,218) = 3.84$, $\underline{p} \simeq .05$; $\underline{F}_1(1,27) = 12.03$, $\underline{p} < .01$; $\underline{F}_2(1,571) = 5.64$, $\underline{p} < .05$. This is the main finding of interest, and will be considered further in the discussion section.

Discussion

The main aspects of the adjunct access model are as follows: (a) Lexical access will be direct (i.e., via the orthographic dictionary) when subjects are aware that a speech code will hinder performance; (b) direct lexical access is followed by an automatic but relatively slow adjunct access of phonological information; (c) lexical access will be mediated (i.e., via the phonological dictionary) when a speech code is necessary for a decision; (d) when a speech code is neither necessary nor harmful, mediated access will occur at least some of the time; (e) following lexical access via either dictionary, there is a rapid automatic access of semantic information; (f) when a decision is based on one type of information (orthographic, phonological, or semantic), other irrelevant information can contribute to the decision if it is available before the decision is made. This contribution can be either positive or negative, depending on the relationship between the irrelevant and relevant information. The decision component of this model is based on the decision model proposed by Logan (1980).

This adjunct access model can account for the pattern of results found in the studies reviewed in the introduction. It also makes the non-intuitive prediction that semantic relatedness will interact with decisions about the phonological relationship of words. The results of the reported experiment support this prediction. Specifically, there was a significant interaction between type of decision (same vs. different number of syllables) and semantic relatedness.

Examination of the data given in Table 1 suggests that relatedness facilitated the decision for same pairs, but that there was no effect for different pairs. However, the main effect of relatedness may be obscuring the true pattern of the interaction. Overall, related pairs were responded to 47 msec more quickly than unrelated pairs. Since semantic relatedness would be expected to facilitate same decisions, reaction times for the SR pairs should be faster than those for the SU pairs for two reasons, the main effect of relatedness and the specific facilitation of relatedness on the same decision. However, these two effects will work in opposite directions for the different decisions. The main effect of relatedness would make reaction times faster for DR pairs than for DU pairs, but semantic relatedness should interfere with different decisions.

The important point is that there was a significant interaction of decision type and semantic relatedness, as predicted by the adjunct access model. This prediction would never have been derived from mediated access models, although they could be modified to account for the obtained finding. This would require postulating a rapid, automatic access of semantic information following mediated access, coupled with a decision model such as that incorporated into the adjunct access model. However,

this revised mediated access model would still be unable to account for why there is an orthography-phonology conflict effect when the distractors are pseudowords, but not when the distractors are illegal nonwords (Shulman, et al., 1978). If phonological information is available before other information, it should always contribute to the decision.

One final point about the adjunct access model is that it suggests a revision in the model proposed by Kleiman (1975). According to this model of sentence reading by college readers, lexical access is typically direct, although mediated access will occur in some cases. After lexical access, representations of the words are stored in a temporary storage buffer so that sentence comprehension processes can operate. These post-lexical access processes are grouped together in a working memory stage, and it is at this stage that a speech code comes into play. Most likely, the speech code serves to increase the amount of information that can be held in the temporary storage buffer.

According to Kleiman's (1975) model, when a speech code is needed for working memory, it is obtained via recoding processes similar to those that can operate prior to lexical access. However, the adjunct access model suggests that this type of recoding would not be necessary. Phonological representations would be useful when the words cannot be processed and purged from working memory rapidly enough for visual temporary storage to be sufficient. It is in just this case that there would be time for the adjunct access of phonological representations. That is, when needed for working memory processing, phonological representations would be automatically available via the links between the orthographic and phonological dictionaries.

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Footnotes

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[1]This is not logically necessary when the distractors are illegal nonwords, but, as will be discussed, Shulman et al. (1978) provide evidence that lexical access occurs for words even in this case.

[2]It is not clear whether this is complete conscious control. For example, subjects may not be able to alter whether access is direct or mediated simply in response to instructions to do so.

[3]This assumes, of course, that the subject has sufficient information to know whether a speech code would be helpful or harmful in the task.

[4]This account makes the same assumptions about word frequency effects and mediated access as do Rubenstein et al. (1971) and Davelaar et al. (1978).

[5]This number of syllables decision was used rather than a rhyming decision because of the difficulties of locating word pairs that rhyme, are semantically related, and do not confound orthographic and phonological similarity.

Table 1

Stimulus Sets, Examples, Mean Reaction Times, and Error Rates

Stimulus Set	Examples	Mean Reaction Times	Error Rates
Same decision - Related (SR)	black-white cheese-milk	1158	.03
Same decision - Unrelated (SU)	black-milk cheese-white	1240	.04
Different decision - Related (DR)	table-chair monkey-chimp	1297	.03
Different decision - Unrelated (DU)	table-chimp monkey-chair	1309	.04